REMARKS

The above amendments and these remarks are responsive to the Office action dated August 9, 2005. Claims 1-60 were pending in the application. Upon entry of the above amendments, claims 1-15, 17-19, 21-47, 50-51, 53-59, and 61-68 are pending in the application. The Office action can be summarized as follows:

- Claims 1-12, 24-28 and 60 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,685,890 to Okada et al. ("Okada").
- Claim 13 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Okada in view of U.S. Patent No. 4,098,959 to Fanciullo ("Fanciullo").
- Claims 14-15 and 46-47 were withdrawn from consideration by the Examiner for being directed to a non-elected species.
- Claims 16-23 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Okada in view of U.S. Patent No. 6,451,464 to Edlund et al. ("Edlund").
- Claims 29-44 and 56-59 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Okada in view of U.S. Patent No. 5,861,137 to Edlund et al. ("Edlund II").
- Claim 45 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Okada in view of Edlund II and Fanciullo.
- Claims 48-55 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Okada in view of Edlund and Edlund II.

With the entry of the above amendments, claims 1, 13, 17-19, 21-22, 25, 36, 45, 50-51 and 53-54 are amended; claims 14-15 and 46-47 are withdrawn from consideration pending allowance of the claims from which they depend; claims 16, 20, 48-49, 52 and 60 are cancelled without prejudice; and new claims 61-68 are added. In the following discussion, Applicant presents the pending claims in numerical order to ease the time and effort reconsidering these claims. In view of the amendments above, and the remarks below, Applicant

respectfully requests reconsideration of the application under 37 C.F.R. § 1.111 and allowance of the pending claims.

Amendments Made For Reasons Un-Related to Patentability

As a preliminary matter, Applicant presents several amendments that are not based on any rejections or objections asserted by the Examiner, and do not narrow the scope of the claims. Rather, these amendments are intended to clarify the relationships between various claimed structures, and/or to provide for proper antecedent basis in the claims. For example, independent claims 1, 17 and 36 each originally recited "**at least one** sulfur-absorbent bed." These claims have each been amended to recite "**a** sulfur absorbent bed" to clarify the relationship between any particular bed and other claimed structures (e.g. sensors, controllers, etc.). These amendments are not intended to preclude a fuel processing system comprising "a sulfur-absorbent bed" from having more than one bed. Stated otherwise, any fuel processing system having more than one bed does, in fact, include ***a*** sulfur-absorbent bed. Dependent claims 13, 18-19, 21-22, 45, 50-51 and 53-54 have each been amended to provided for proper antecedent basis in the claims. Claim 25 has been amended to correct a spelling error.

Claims 1-15 and 61-62

Amended claim 1 includes amended subject matter from original claim 16 re-written in independent form. Original claim 16 claimed a fuel processing system including, amongst other structure, at least one sulfur-absorbent bed, each having "a capacity of absorbed sulfur," and "at least one sensor adapted to measure the percentage of the capacity at which each of the beds is operating." This subject matter was amended and added to original claim 1 to form amended claim 1. Specifically, amended claim 1 claims a fuel processing system including, amongst other structure, a sulfur-absorbent bed having "a capacity of absorbed

sulfur," and "a sensor adapted to measure the sulfur content absorbed by the bed." The sensor claimed in amended claim 1 is adapted to measure the amount of sulfur absorbed by the bed, which necessarily corresponds to a percentage of the bed's total capacity of absorbed sulfur.

The subject matter presented in original claim 16 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Okada and Edlund. In the Office action, the Examiner asserts that Okada discloses a fuel processing system having a sulfur-absorbent bed with a capacity of absorbed sulfur, but fails to disclose a fuel processing system that includes a sensor for measuring the percentage of the capacity at which the bed is operating. The Examiner also asserts that Edlund "teaches a fuel processing system wherein each of the absorbent beds (30) has a capacity of absorbed impurities (col. 2, lines 41-48 and 60-65) and further wherein the fuel processing system includes at least one sensor (52) in order to detect the concentration of a specific component (col. 4, lines 13-24). Finally, the Examiner concludes that it would have been obvious to include at least one of Edlund's sensors in Okada's sulfur-absorbent bed in order to detect the concentration of a specific component.

Applicant respectfully disagrees with the Examiner's conclusions with respect to original claim 16. However, as discussed above, the subject matter claimed in original claim 16 was amended prior to being added to claim 1. Applicant therefore believes that the specifics of amended claim 1 should be discussed instead of focusing upon the specifics of the Examiner's rejection of claim 16. Due to the similarities between the subject matter recited in the original claim 16 and the amended claim 1, Applicant will assume that the Examiner will apply the same obviousness rejection to amended claim 1. Accordingly, Applicant asserts that amended claim 1 is not obvious over the combination of Okada and Edlund.

Okada discloses a process and sulfur-absorbent composition for removing sulfur from hydrocarbons prior to steam reforming of the hydrocarbons. The process utilizes a sulfur-absorbent bed that contains a desulfurization agent that is highly selective for sulfur compounds. Because sulfur readily contaminates steam reforming catalysts, the sulfur-absorbent bed is positioned upstream of a steam reformer to remove contaminating sulfur from the hydrocarbon feedstock. (Col. 1, lines 19-25, and Fig. 2). Okada stresses the importance of a highly selective sulfur-absorbent bed, stating that "as shown by the research of McCarty et al. ... the sulfur adsorptivity of [steam reforming catalysts] is so powerful that the most part of the catalyst surface is covered by sulfur even if the sulfur content of the [feedstock] is trace." (Col. 1, lines 55-63). As correctly recognized by the Examiner, Okada does not show a fuel processing system that includes a sensor for measuring the percentage of the capacity at which the bed is operating. Okada also does not teach or suggest a sensor for measuring the sulfur content absorbed by the bed, as claimed in amended claim 1.

Edlund discloses a fuel processor for producing hydrogen gas. The fuel processor includes a hydrogen-producing region 24 for producing a product stream 26, such as via a steam reforming process. (Col. 2, lines 31-39). The product stream includes hydrogen gas, and byproducts (such as carbon dioxide gas and carbon monoxide gas) that may damage a fuel cell stack. (Col. 2, lines 39-40). In order to remove these impurities, Edlund discloses a separation region 30 for purifying the product hydrogen before it leaves the fuel processor. The separation region may include a hydrogen permeable membrane, an absorbent bed, or a catalytic reactor. (Col. 2, lines 51-65). The separation region is located downstream of the hydrogen-producing region (i.e. the steam reformer) and therefore is removing impurities from the gaseous product stream from the reformer, not the feedstock for the reformer. (Fig. 2). Edlund does not teach or

suggest using the separation region or any other component for selectively removing sulfur from the product stream. In fact, Edlund makes no mention of sulfur compounds, as these compounds would not be expected to be present in the gaseous, primarily hydrogen, stream produced by the reformer.

In addition to the fuel processor, Edlund discloses "a control system 50 that monitors the composition of the product stream leaving the fuel processor." (Col. 4, lines 11-13). The control system includes a sensor assembly 52, which includes one or more sensors adapted to detect the concentration of components or impurities *in the product stream.* (Col. 4, lines 8-22). The control system functions "to protect the fuel cell stack 14 from being damaged should the product stream contain concentrations of harmful components that are above threshold levels." (Col. 4, lines 1-3). Edlund does not teach or suggest a sensor for selectively sensing sulfur, as it makes no mention of sulfur being an impurity that can be found in the product stream. Edlund also does not teach or suggest a sensor that senses the concentration of an impurity absorbed by a bed. Rather, the sensors sense the concentration of impurities that have *not* been removed from the purified hydrogen product stream by the separation region. Edlund's sensor therefore indicates when a problem has already occurred with the separation region, rather than foreshadowing an impending problem with the separation region.

The combination of Edlund and Okada does not teach each and every element claimed in amended claim 1. For example, neither Edlund nor Okada teach "a sensor adapted to measure the sulfur content absorbed by [a sulfur-absorbent] bed." Because Edlund discloses a sensor that detects impurities in a product stream downstream of the steam reforming region, the sensor indirectly indicates when a separation region (i.e. a hydrogen permeable membrane, catalytic reactor, or absorbent bed) is no longer functioning to separate impurities from the

gaseous product stream produced by the steam reforming reaction. Moreover, Edlund's sensor does not measure, either directly or indirectly, the actual content of an impurity absorbed by an absorbent bed. Further, while Edlund discloses a sensor that detects concentrations of impurities in a product stream downstream of a fuel processor, Edlund does not disclose that the sensor detects sulfur. Therefore, in order to teach each and every element of amended claim 1, Edlund's sensor would have to be modified to (1) measure the content of an impurity absorbed by an absorbent bed, and (2) selectively measure sulfur content, and (3) be adapted to measure this sulfur content arising from the carbon-containing feedstock for the reforming reaction (i.e., upstream of the hydrogen-producing region).

There is no motivation or suggestion to modify Edlund's sensor to measure the content of an impurity absorbed by an absorbent bed, because the modification would change the sensor's principle of operation. As discussed above, Edlund discloses a sensor that functions by directly detecting the concentration of a component or impurity in the product stream *after* it has passed through a separation region, and does not measure the concentration of impurities absorbed by an absorbent bed. This distinction is important because, as indicated in Okada, even trace amounts of sulfur will contaminate the steam reforming catalysts. Even if Edlund's sensor is modified to detect sulfur in the feedstock after it has passed through Okada's sulfur-absorbent bed, then the sensor will be indicating that the bed has already absorbed too much sulfur, and the steam reforming catalysts will be contaminated by the trace amounts of sulfur entering the steam reformer. In order to prevent contamination of the steam reforming catalysts, Edlund's sensor would have to be modified to directly or indirectly measure the sulfur content absorbed by Okada's sulfur-absorbent bed itself, as claimed in amended claim 1. The modified sensor may thereby enable a user to monitor the sulfur content absorbed by the bed, and to regenerate or

replace the sulfur-absorbent bed before it has absorbed too much sulfur to effectively remove sulfur from the feedstock. This modification, however, would change the principle of operation of Edlund's sensor.

Modifying Edlund's sensor to measure the content of an impurity absorbed by an absorbent bed would also render the sensor unsatisfactory for most of its intended purposes. Specifically, the sensor disclosed in Edlund directly detects impurities in the product stream downstream of various separation regions, such as hydrogen permeable membranes, absorbent beds, or catalytic reactors. Many of these separation regions, such as hydrogen permeable membranes and catalytic reactors, do not absorb any impurities, and require Edlund's unmodified sensor to determine whether the separation region is malfunctioning. Because a modified sensor would not function in these cases, the proposed modification renders the sensor unsatisfactory for its intended purposes.

There is also no motivation or suggestion to modify Edlund's sensor to selectively measure sulfur content, because the modification would render the sensor unsatisfactory for its intended purpose. The intended purpose of Edlund's sensor is to detect components or impurities in the gaseous product hydrogen stream that would cause damage to a fuel cell stack. Edlund makes no mention of sulfur being an impurity that can be found in the product stream downstream of the fuel processor. Accordingly, Edlund makes no mention of detecting sulfur with a sensor. Instead, Edlund only discloses sensors that detect common byproducts of the steam reforming process (i.e. carbon monoxide, carbon dioxide, etc.) that can pass through a malfunctioning separation region downstream of a steam reformer. Therefore, modifying Edlund's sensor to measure sulfur content would render the sensor unsatisfactory for its intended purpose.

Applicant respectfully requests allowance of claim 1 for at least the reasons discussed above. Claims 2-15 depend from amended claim 1, and therefore should be allowed when amended claim 1 is allowed. New claims 61-62 also depend from amended claim 1, and therefore should be allowed when amended claim 1 is allowed.

Claims 17-19, 21-35, and 63-64

Amended claim 17 includes the subject matter from original claim 17 amended and re-written in independent form. Original claim 17 recited a fuel processing system including, amongst other structure, at least one sulfur-absorbent bed, each having "a capacity of absorbed sulfur," and "a controller that is adapted to determine when a threshold value corresponding to a predetermined percentage of the capacity has been reached and to trigger a user-notifying event responsive thereto." This subject matter was amended and added to the subject matter originally presented in claim 1 to form amended claim 17. Specifically, amended claim 17 recites a fuel processing system including, amongst other structure, a sulfur-absorbent bed having "a capacity of absorbed sulfur," and "a controller adapted to determine when the bed has absorbed at least a threshold level of sulfur that corresponds to a predetermined percentage of the bed's capacity, and to trigger a user-notifying event in response to the determination."

The subject matter presented in original claim 17 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Okada and Edlund. In the Office action, the Examiner asserts that Okada discloses a fuel processing system having a sulfur-absorbent bed with a capacity of absorbed sulfur, but fails to show a fuel processing system that includes a controller that is adapted to determine when a threshold value corresponding to a predetermined percentage of the capacity has been reached and to trigger a user-notifying event thereto. The Examiner also asserts that Edlund teaches "a controller (54) that is adapted to determine when a

threshold value corresponding to a predetermined percentage of the capacity has been reached and to trigger a user-notifying event responsive thereto in order to alert users that there has been a failure (col. 4, lines 31-42) and (col. 6, lines 53-58)." Finally, the Examiner concludes that it would have been obvious to include Edlund's controller in Okada's reformer in order to alert users that there has been a failure.

Applicant respectfully disagrees with the Examiner's conclusions with respect to original claim 17. However, as discussed above, the subject matter claimed in original claim 17 was amended and re-written in independent form. Applicant therefore will discuss how amended claim 17 patentably distinguishes the combination of Okada and Edlund proposed in the Office action with respect to original claim 17. Applicant asserts that amended claim 17 is not obvious over the combination of Okada and Edlund, each of which have been described above with respect to claim 1.

The combination of Okada and Edlund does not teach each and every element claimed in amended claim 17. For example, neither Okada nor Edlund teach "a controller adapted to determine when [a sulfur-absorbent] bed has absorbed at least a threshold level of sulfur." While Edlund discloses a controller that detects concentrations of impurities in a product stream downstream of a fuel processor, Edlund does not disclose a controller that selectively detects sulfur, much less sulfur in the carbon-containing feedstock for a steam reforming reaction. Therefore, Edlund's controller would have to be modified to selectively measure sulfur content in order to teach each and every element of amended claim 17.

There is no motivation or suggestion to modify Edlund's controller to selectively measure sulfur content, because the modification would render the controller unsatisfactory for its intended purpose. The intended purpose of Edlund's controller is to monitor the composition

of the product hydrogen stream leaving the fuel processor, so as to detect components or impurities in the product stream that would cause damage to a fuel cell stack. Edlund makes no mention of sulfur being an impurity that can be found in the product stream downstream of the fuel processor. Accordingly, Edlund makes no mention of a controller that detects sulfur. Instead, Edlund only discloses controllers having sensors that detect common byproducts of the steam reforming process (i.e. carbon monoxide, carbon dioxide, etc.) that can pass through a malfunctioning separation region downstream of a steam reformer. Therefore, modifying the Edlund controller to measure sulfur content would render the controller unsatisfactory for its intended purpose.

Applicant respectfully requests allowance of claim 17 for at least the reasons discussed above. Claims 18-19 and 21-35 depend from amended claim 17, and therefore should be allowed when amended claim 17 is allowed. New claims 63-64 and 67 also depend from amended claim 17, and therefore should be allowed when amended claim 17 is allowed.

Claims 36-47, 50-51, 53-59 and 65-66

Amended claim 36 includes subject matter from original claim 49 amended and re-written in independent form. Original claim 49 claimed a fuel processing system including, amongst other structure, at least one sulfur-absorbent bed, each having "a capacity of absorbed sulfur," and "a controller that is adapted to determine when a threshold value corresponding to a predetermined percentage of the capacity has been reached and to trigger a user-notifying event responsive thereto." This subject matter was amended and added to the subject matter originally presented in claim 36 to form amended claim 36. Specifically, amended claim 36 claims a fuel processing system including, amongst other structure, a sulfur-absorbent bed having "a capacity of absorbed sulfur," and "a controller adapted to determine when the bed has absorbed at least a

threshold level of sulfur that corresponds to a predetermined percentage of the bed's capacity, and to trigger a user-notifying event in response to the determination."

The subject matter presented in original claim 49 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Okada and Edlund II, as applied to claim 36, and further in view of Edlund. Specifically, the Examiner asserts that Okada shows a fuel processing system having a sulfur-absorbent bed with a capacity of absorbed sulfur, but fails to show a fuel processing system (i.e. steam reformer) that includes a controller adapted to determine when a threshold value corresponding to a predetermined percentage of the capacity has been reached and to trigger a user-notifying event thereto. The Examiner also asserts that Edlund teaches "a controller (54) that is adapted to determine when a threshold value corresponding to a predetermined percentage of the capacity has been reached and to trigger a user-notifying event responsive thereto in order to alert users that there has been a failure (col. 4, lines 31-42) and (col. 6, lines 53-58)." Finally, the Examiner concludes that it would have been obvious to include Edlund's controller in Okada's steam reformer in order to alert users that there has been a failure.

Applicant respectfully disagrees with the Examiner's conclusions with respect to original claim 49. However, as discussed above, the subject matter claimed in original claim 49 was amended prior to being added to claim 36. Applicant therefore will discuss how amended claim 36 patentably distinguishes the proposed combination of references set forth in the Office action with respect to original claim 49. Accordingly, Applicant asserts that amended claim 36 is not obvious over the combination of Okada in view of Edlund, each of which have been described above with respect to claim 1.

The combination of Okada and Edlund does not teach each and every element claimed in amended claim 36. Specifically, neither Okada nor Edlund teach "a controller adapted to determine when [a sulfur-absorbent] bed has absorbed at least a threshold level of sulfur." While Edlund discloses a controller that detects concentrations of impurities in a product stream downstream of a fuel processor, Edlund does not disclose a controller that selectively detects sulfur. Therefore, Edlund's controller would have to be modified to selectively measure sulfur content in order to teach each and every element of amended claim 36.

There is no motivation or suggestion to modify Edlund's controller to selectively measure sulfur content, because the modification would render the controller unsatisfactory for its intended purpose. The intended purpose of Edlund's controller is to monitor the composition of the product stream leaving the fuel processor, so as to detect components or impurities in the product stream that would cause damage to a fuel cell stack. Edlund makes no mention of sulfur being an impurity that can be found in the product stream downstream of the fuel processor. Even if sulfur is an impurity that can be found in the product stream, Edlund makes no mention of a controller that detects sulfur. Instead, Edlund only discloses controllers having sensors that detect common byproducts of the steam reforming process (i.e. carbon monoxide, carbon dioxide, etc.) that can pass through a malfunctioning separation region downstream of a steam reformer. Therefore, modifying the Edlund controller to measure sulfur content would render the controller unsatisfactory for its intended purpose.

Applicant respectfully requests allowance of amended claim 36 for at least the reasons discussed above. Claims 36-47, 50-51 and 53-59 depend from amended claim 36, and therefore should be allowed when amended claim 36 is allowed. New claims 65-66 and 68 also

depend from amended claim 36, and therefore should be allowed when amended claim 36 is allowed.

Applicant believes that this application is now in condition for allowance, in view of the above amendments and remarks. Accordingly, Applicant respectfully requests that the Examiner issue a Notice of Allowability covering the pending claims. If the Examiner has any questions, or if a telephone interview would in any way advance prosecution of the application, the Examiner is invited to contact the undersigned attorney of record.

Respectfully submitted,

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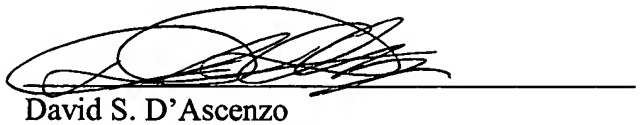

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